

P27374.A11

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	: Dureseti CHIDAMBARRAO, et al.	Group Art Unit: 2814
Appln. No.	: 10/605,108	Examiner: PHAM, Long
Filed	: September 9, 2003	Confirmation No. 2107
For	: METHOD FOR REDUCED N+ DIFFUSION IN STRAINED SI ON SI/GE SUBSTRATE	

**APPEAL BRIEF UNDER 37 C.F.R. § 41.37**

Commissioner for Patents  
U.S. Patent and Trademark Office  
Customer Window, Mail Stop Appeal Brief-Patents  
Randolph Building  
401 Dulany Street  
Alexandria, VA 22314  
Sir:

This appeal is from the Examiner's final rejection of claims 16-18, 22-28 and 30-39 as set forth in the Final Office Action of June 8, 2006. A Notice of Appeal and a Request For Pre-Appeal Brief Review, in response to the June 8, 2006 Final Office Action, was filed on August 30, 2006.

Please charge the requisite fee under 37 C.F.R. 41.20(b)(2) in the amount of \$500.00 for the filing of the Appeal Brief to Deposit Account No. 09-0458. No additional fee is believed to be required for filing the instant Appeal Brief. However, if for any reason a necessary fee is required for consideration of the instant paper, authorization is hereby given to charge the fee for the Appeal Brief and any necessary extension of time fees to Deposit Account No. 09-0458.

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**(I) REAL PARTY IN INTEREST**

The real party in interest is International Business Machines Corporation by an assignment recorded in the U.S. Patent and Trademark Office on September 9, 2003, at Reel 013951 and Frame 0696.

**(II) RELATED APPEALS AND INTERFERENCES**

No related appeals and/or interferences are pending.

**(III) STATUS OF THE CLAIMS**

Claims 16-18, 22-28 and 30-39 stand finally rejected. Claims 1-15, 19-21 and 29 are canceled. Claims 16-18, 22-28 and 30-39 are pending and are part of this appeal. The claims in issue are attached in the "Claims Appendix".

**(IV) STATUS OF THE AMENDMENTS**

A Response under 37 C.F.R. § 1.116 was filed July 27, 2006, requesting reconsideration of the finally rejected claims. The Examiner responded with an Advisory Action mailed August 16, 2006, indicating that the request for reconsideration was considered, but did not place the application in condition for allowance. Appellant submits that no other amendments after final have been filed; however, all amendments to the claims have been entered.

**(V) SUMMARY OF THE CLAIMED SUBJECT MATTER**

**A. The Claimed Subject Matter**

**1. INDEPENDENT CLAIM 16**

With reference to pages 3-6 of the instant application and to the figures, and by

way of non-limiting example, the invention provides for a method for reducing diffusion of an N type impurity in a SiGe-based substrate (see page 3, lines 1-7 of the instant specification). The method comprises the steps of forming source and drain extension regions (24) in an upper surface of the SiGe-based substrate (see page 3, line 30 to page 4, line 2 and page 4, lines 30-31) and ion implanting an interstitial element into the source and drain extension regions (24) to reduce vacancy concentration in the source and drain extension regions (see page 4, lines 11-17) and to form low-vacancy regions that substantially overlap the source and drain extension regions (see page 4, lines 11-14).

## **2. INDEPENDENT CLAIM 38**

With reference to pages 3-6 of the instant application and to the figures, and by way of non-limiting example, the invention provides for a method for reducing diffusion of an N type impurity in a SiGe-based substrate (see page 3, lines 1-7 of the instant specification). The method comprises the steps of forming an Si cap layer (14) on the SiGe substrate (see page 3, lines 18-20), forming a gate electrode (18) on the Si cap layer (see page 3, line 24), forming sidewalls (20) on sides of the gate electrode (see page 3, lines 26-29), forming source and drain extension regions in an upper surface of the SiGe-based substrate (see page 3, line 30 to page 4, line 2 and page 4, lines 30-31), and ion implanting an interstitial element into the source and drain extension regions to reduce vacancy concentration in the source and drain extension regions (see page 4, lines 11-18). The ion implanting occurs after the sidewalls (20) are formed (see Fig. 4 and page 4, lines 10-14).

### **3. INDEPENDENT CLAIM 39**

With reference to pages 3-6 of the instant application and to the figures, and by way of non-limiting example, the invention provides for a method for reducing diffusion of an N type impurity in a SiGe-based substrate (see page 3, lines 1-7 of the instant specification). The method comprises the steps of forming an Si cap layer (14) on the SiGe substrate (see page 3, lines 18-20), forming a gate electrode (18) on the Si cap layer (see page 3, line 24), forming sidewalls (20) on sides of the gate electrode (see page 3, lines 26-29), forming source and drain extension regions in an upper surface of the SiGe-based substrate (see page 3, line 30 to page 4, line 2 and page 4, lines 30-31), and reducing a vacancy concentration in the source and drain extension regions using ion implantation in order to annihilate excess vacancies or trap vacancies (page 4, lines 11-20). The reducing occurs after the sidewalls 20) are formed (see Fig. 4 and page 4, lines 10-14) and forms low-vacancy regions that substantially overlap the source and drain extension regions (see page 4, lines 10-14).

### **(VI) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL**

**Whether claims 16-18, 22-28 and 30-39 are improperly rejected under 35 U.S.C. § 103(a) as unpatentable over Applicant's Admitted Prior Art (AAPA) in view of U.S. Patent No. 6,200,836 issued to YOO.**

### **(VII) ARGUMENT RE. 103(a) REJECTION**

#### **REJECTION OF INDEPENDENT CLAIM 16 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 16 under 35 U.S.C. § 103(a) as being unpatentable over AAPA in view of YOO is in error, the decision of the Examiner to reject this claim should

be reversed, and the application should be remanded to the Examiner.

The Examiner acknowledges that AAPA lacks, among other things, ion implanting an interstitial element onto the source and drain extension regions and forming low-vacancy regions that substantially overlap the source and drain extension regions. The Examiner nevertheless asserts that YOO teaches the former feature, that the latter feature is inherent based on the combination of these teachings, and that it would have been obvious to combine the teachings of AAPA and YOO in order to render this claim unpatentable.

Appellants submit that the Examiner has failed to set forth a *prima facie* case of unpatentability because no proper combination of AAPA and YOO disclose or suggest at least the following features:

Independent claim 16 specifically recites, among other things:

ion implanting an interstitial element into the source and drain extension regions to reduce vacancy concentration in the source and drain extension regions and to form low-vacancy regions that substantially overlap the source and drain extension regions.

These features are simply not disclosed or suggested by any proper combination of AAPA and YOO. Appellants acknowledge that YOO discloses implanting oxygen 30 to the regions 16 and 18 in order to form oxide layers 38 and source and drain regions 32 (see Figs. 2 and 3). However, in addition to failing to disclose the recited SiGe substrate (col. 3, line 44 of YOO explains only that layer 12 is a gate oxide), Appellants submit that YOO also fails to disclose, or even suggest, ion implanting an interstitial element into the source and drain extension regions to reduce vacancy concentration in

the source and drain extension regions and to form low-vacancy regions that substantially overlap the source and drain extension regions. To the contrary, Fig. 2 of YOO shows that the oxygen implantation is focused onto only a tiny portion of the regions 16 and 18. The regions 16 and 18 in Fig. 2 or YOO are not disclosed in YOO as being source and drain extension regions. Furthermore, Fig. 3 shows that the resulting barrier 38 only overlaps, if at all (which Appellants would dispute because YOO describes barrier 38 as an oxide interface layer at col. 4, line 32), a small portion of the source/drain regions 32. As such, YOO clearly fails to specifically disclose or suggest that the oxygen implantation 30 forms low-vacancy regions that substantially overlap the source and drain extension regions, that is, that overlap nearly all of the source and drain regions 32, much less, source/drain extension regions 34 and 36.

Furthermore, because YOO discloses that the oxygen implantation occurs at an angle of between 30 and 60 degrees (see col. 4, line 4-7) and at a dose that is only in the range of  $1 \times 10^{12}$  to  $1 \times 10^{13}$  atoms/cm<sup>3</sup> (see col. 4, lines 1-4), it is not apparent that such an implantation step would result in the formation of low-vacancy regions that substantially overlap the source and drain extension regions. Appellants remind the Examiner that the ion implantation of the invention occurs at higher concentrations such as, e.g.,  $1 \times 10^{14}$  to  $1 \times 10^{16}$  atoms/cm<sup>2</sup>, that Fig. 4 of the instant application clearly shows that the ion implantation B occurs over most of the source/drain extension regions 24, and that, as a result, the low-vacancy regions 26 substantially overlap the source and drain extension regions 24.

As such, YOO simply cannot cure the noted deficiencies of AAPA (even

assuming the Examiner's characterization of the AAPA is correct - which Appellants dispute). Again, YOO clearly fails to disclose, or even suggest, that the disclosed implanting of oxygen is suggestive of ion implanting an interstitial element into the source and drain extension regions to reduce vacancy concentration in the source and drain extension regions and to form low-vacancy regions that substantially overlap the source and drain extension regions. Instead, the actual disclosure of YOO teaches away from these features by implanting oxygen to only a portion of the regions 32 and by performing the implantation before the sidewalls are formed.

Finally, Appellants disagree with the Examiner's assertions that the resulting low-vacancy regions formed by the combination of AAPA and YOO "would inherently and substantially overlap the source and drain extension regions." Such assertions are entirely unsupported by any disclosure of any of the applied prior art. As explained above, YOO merely discloses that the oxygen implantation occurs at an angle of between 30 and 60 degrees (see col. 4, line 4-7) and at a dose that is only in the range of  $1 \times 10^{12}$  to  $1 \times 10^{13}$  atoms/cm<sup>3</sup> (see col. 4, lines 1-4). Moreover, Fig. 3 shows that the implantation results only in "a firm barrier 38" formed in regions 32. The invention, on the other hand, provides that the ion implantation occurs at higher concentrations such as, e.g.,  $1 \times 10^{14}$  to  $1 \times 10^{16}$  atoms/cm<sup>2</sup>. Moreover, Fig. 4 of the instant application clearly shows that the ion implantation B is focused over most of the regions 24 rather than only a portion of regions 16 and 18 (see Fig. 2 of YOO). Finally, whereas the invention results in the low-vacancy regions 26 substantially overlapping the source and drain extension regions 24, the steps shown in Figs. 2 and 3 of YOO result in "oxide layers 38



at the interface between the source/drain regions 32 and the surrounding silicon substrate" (emphasis added). Thus, it is not inherent from the disclosure of YOO that such an implantation step would result the formation of low-vacancy regions that substantially overlap the source and drain extension regions.

Because the combination of the above-noted documents fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellants submit that no proper combination of these documents renders unpatentable the combination of features recited in at least independent claim 16.

**REJECTION OF INDEPENDENT CLAIM 38 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 38 under 35 U.S.C. § 103(a) as being unpatentable over AAPA in view of YOO is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

The Examiner acknowledges that AAPA lacks, among other things, ion implanting an interstitial element onto the source and drain extension regions and reducing vacancy concentration in the source and drain extension regions. The Examiner nevertheless asserts that YOO teaches the former feature, that the latter feature is inherent based on the combination of these teachings, and that it would have been obvious to combine the teachings of AAPA and YOO in order to render this claim unpatentable.

Appellants submit that the Examiner has failed to set forth a *prima facie* case of unpatentability because no proper combination of AAPA and YOO disclose or suggest at least the following features:

Independent claim 38 specifically recites, among other things:

forming sidewalls on sides of the gate electrode; and  
ion implanting an interstitial element into the source and drain extension  
regions to reduce vacancy concentration in the source and drain  
extension regions,  
wherein the ion implanting occurs after the sidewalls are formed.

These features are simply not disclosed or suggested by any proper combination of AAPA and YOO. As explained above, Appellants acknowledge that YOO discloses implanting oxygen 30 to the regions 16 and 18 in order to form oxide layers 38 and source and drain regions 32 (see Figs. 2 and 3). However, in addition to failing to disclose the recited SiGe substrate (col. 3, line 44 of YOO explains only that layer 12 is a gate oxide), Appellants submit that YOO also fails to disclose, or even suggest, ion implanting an interstitial element into the source and drain extension regions to reduce vacancy concentration in the source and drain extension regions. To the contrary, Fig. 2 of YOO shows that the oxygen implantation is focused onto only a tiny portion of the regions 16 and 18. Furthermore, Fig. 3 shows that the resulting barrier 38 only overlaps, if at all, a small portion of the source/drain regions 32. As such, YOO clearly fails to specifically disclose or suggest that the oxygen implantation 30 forms low-vacancy regions in the source and drain extension regions 34 and 36.

Furthermore, because YOO discloses that the oxygen implantation occurs at an angle of between 30 and 60 degrees (see col. 4, line 4-7) and at a dose that is only in the range of  $1 \times 10^{12}$  to  $1 \times 10^{13}$  atoms/cm<sup>3</sup> (see col. 4, lines 1-4), it is not apparent that such an implantation step would result in the formation of low-vacancy regions in the source and drain extension regions. Appellants remind the Examiner that the ion

implantation of the invention occurs at higher concentrations such as, e.g.,  $1 \times 10^{14}$  to  $1 \times 10^{16}$  atoms/cm<sup>2</sup>, that Fig. 4 of the instant application clearly shows that the ion implantation B occurs over most of the source/drain extension regions 24, and that, as a result, the low-vacancy regions 26 are formed in the source and drain extension regions 24.

Appellants also acknowledge that YOO discloses, in addition to the implantation step shown in Fig. 2, the step of forming the sidewalls 33 (see Fig. 3). However, it is clear from the description of Figs. 2 and 3, as well as the drawings themselves, that the oxygen implantation 30 occurs before the sidewalls 33 are formed. Claim 38, on the other hand, specifically recites that the ion implanting occurs after the sidewalls are formed. Furthermore, the Examiner has failed to identify any disclosure in YOO which discloses or suggests that the steps shown in Figs. 2 and 3 of YOO (which clearly show that the ion implanting occurs before the sidewalls are formed) could be reversed.

As such, YOO simply cannot cure the noted deficiencies of AAPA (even assuming the Examiner's characterization of the AAPA is correct - which Appellants dispute). Again, YOO clearly fails to disclose, or even suggest, that the disclosed implanting of oxygen is suggestive of ion implanting an interstitial element into the source and drain extension regions to reduce vacancy concentration in the source and drain extension regions. Instead, the actual disclosure of YOO teaches away from these features by implanting oxygen to only a portion of the regions 32 and by performing the implantation before the sidewalls are formed.

Finally, Appellants disagree with the Examiner's assertions that the resulting low-

vacancy regions formed by the combination of AAPA and YOO "would be inherently reduced". Such assertions are entirely unsupported by any disclosure of any of the applied prior art. As explained above, YOO merely discloses that the oxygen implantation occurs at an angle of between 30 and 60 degrees (see col. 4, line 4-7) and at a dose that is only in the range of  $1 \times 10^{12}$  to  $1 \times 10^{13}$  atoms/cm<sup>3</sup> (see col. 4, lines 1-4). Moreover, Fig. 3 shows that the implantation results only in "a firm barrier 38" formed in regions 32. The invention, on the other hand, provides that the ion implantation occurs at higher concentrations such as, e.g.,  $1 \times 10^{14}$  to  $1 \times 10^{16}$  atoms/cm<sup>2</sup>. Moreover, Fig. 4 of the instant application clearly shows that the ion implantation B is focused over most of the regions 24 rather than only a portion of regions 16 and 18 (see Fig. 2 of YOO). Finally, whereas the invention results in the low-vacancy regions 26 in the source and drain extension regions 24, the steps shown in Figs. 2 and 3 of YOO result in "oxide layers 38 at the interface between the source/drain regions 32 and the surrounding silicon substrate" (emphasis added). Thus, it is not inherent from the disclosure of YOO that such an implantation step would result in the formation of low-vacancy regions in the source and drain extension regions.

Because the combination of the above-noted documents fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellants submit that no proper combination of these documents renders unpatentable the combination of features recited in at least independent claim 38.

**REJECTION OF INDEPENDENT CLAIM 39 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 39 under 35 U.S.C. § 103(a) as being unpatentable over

AAPA in view of YOO is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

The Examiner acknowledges that AAPA lacks, among other things, ion implanting an interstitial element onto the source and drain extension regions and forming low-vacancy regions that substantially overlap the source and drain extension regions, the Examiner nevertheless asserts that YOO teaches the former feature, that the latter feature is inherent based on the combination of these teachings, and that it would have been obvious to combine the teachings of AAPA and YOO in order to render this claim unpatentable.

Appellants submit that the Examiner has failed to set forth a *prima facie* case of unpatentability because no proper combination of AAPA and YOO disclose or suggest at least the following features:

Independent claim 39 specifically recites, among other things:

forming sidewalls on sides of the gate electrode;  
reducing a vacancy concentration in the source and drain extension regions using ion implantation in order to annihilate excess vacancies or trap vacancies,  
wherein the reducing occurs after the sidewalls are formed and forms low-vacancy regions that substantially overlap the source and drain extension regions.

These features are simply not disclosed or suggested by any proper combination of AAPA and YOO. As explained above, Appellants acknowledge that YOO discloses implanting oxygen 30 to the regions 16 and 18 in order to form oxide layers 38 and source and drain regions 32 (see Figs. 2 and 3). However, in addition to failing to disclose the recited SiGe substrate (col. 3, line 44 of YOO explains only that layer 12 is

a gate oxide), Appellants submit that YOO also fails to disclose, or even suggest, ion implanting an interstitial element into the source and drain extension regions to reduce vacancy concentration in the source and drain extension regions and to form low-vacancy regions that substantially overlap the source and drain extension regions. To the contrary, Fig. 2 of YOO shows that the oxygen implantation is focused onto only a tiny portion of the regions 16 and 18. Furthermore, Fig. 3 shows that the resulting barrier 38 only overlaps, if at all, a small portion of the source/drain regions 32. As such, YOO clearly fails to specifically disclose or suggest that the oxygen implantation 30 forms low-vacancy regions that substantially overlap the source and drain extension regions, that is, that overlap nearly all of the source and drain regions 32, much less, source/drain extension regions 34 and 36.

Furthermore, because YOO discloses that the oxygen implantation occurs at an angle of between 30 and 60 degrees (see col. 4, line 4-7) and at a dose that is only in the range of  $1 \times 10^{12}$  to  $1 \times 10^{13}$  atoms/cm<sup>3</sup> (see col. 4, lines 1-4), it is not apparent that such an implantation step would result in the formation of low-vacancy regions that substantially overlap the source and drain extension regions. Appellants remind the Examiner that the ion implantation of the invention occurs at higher concentrations such as, e.g.,  $1 \times 10^{14}$  to  $1 \times 10^{16}$  atoms/cm<sup>2</sup>, that Fig. 4 of the instant application clearly shows that the ion implantation B occurs over most of the source/drain extension regions 24, and that, as a result, the low-vacancy regions 26 substantially overlap the source and drain extension regions 24.

Appellants also acknowledge that YOO discloses, in addition to the implantation

step shown in Fig. 2, the step of forming the sidewalls 33 (see Fig. 3). However, it is clear from the description of Figs. 2 and 3, as well as the drawings themselves, that the oxygen implantation 30 occurs before the sidewalls 33 are formed. Claim 39, on the other hand, specifically recites that the ion implanting occurs after the sidewalls are formed. Furthermore, the Examiner has failed to identify any disclosure in YOO which discloses or suggests that the steps shown in Figs. 2 and 3 of YOO (which clearly show that the ion implanting occurs before the sidewalls are formed) could be reversed.

As such, YOO simply cannot cure the noted deficiencies of AAPA (even assuming the Examiner's characterization of the AAPA is correct - which Appellants dispute). Again, YOO clearly fails to disclose, or even suggest, that the disclosed implanting of oxygen is suggestive of ion implanting an interstitial element into the source and drain extension regions to reduce vacancy concentration in the source and drain extension regions and to form low-vacancy regions that substantially overlap the source and drain extension regions. Instead, the actual disclosure of YOO teaches away from these features by implanting oxygen to only a portion of the regions 32 and by performing the implantation before the sidewalls are formed.

Finally, Appellants disagree with the Examiner's assertions that the resulting low-vacancy regions formed by the combination of AAPA and YOO "would inherently and substantially overlap the source and drain extension regions." Such assertions are entirely unsupported by any disclosure of any of the applied prior art. As explained above, YOO merely discloses that the oxygen implantation occurs at an angle of between 30 and 60 degrees (see col. 4, line 4-7) and at a dose that is only in the range

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of  $1 \times 10^{12}$  to  $1 \times 10^{13}$  atoms/cm<sup>3</sup> (see col. 4, lines 1-4). Moreover, Fig. 3 shows that the implantation results only in "a firm barrier 38" formed in regions 32. The invention, on the other hand, provides that the ion implantation occurs at higher concentrations such as, e.g.,  $1 \times 10^{14}$  to  $1 \times 10^{16}$  atoms/cm<sup>2</sup>. Moreover, Fig. 4 of the instant application clearly shows that the ion implantation B is focused over most of the regions 24 rather than only a portion of regions 16 and 18 (see Fig. 2 of YOO). Finally, whereas the invention results in the low-vacancy regions 26 substantially overlapping the source and drain extension regions 24, the steps shown in Figs. 2 and 3 of YOO result in "oxide layers 38 at the interface between the source/drain regions 32 and the surrounding silicon substrate" (emphasis added). Thus, it is not inherent from the disclosure of YOO that such an implantation step would result the formation of low-vacancy regions that substantially overlap the source and drain extension regions.

Because the combination of the above-noted documents fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellants submit that no proper combination of these documents renders unpatentable the combination of features recited in at least independent claim 39.

**REJECTION OF DEPENDENT CLAIM 22 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 22 under 35 U.S.C. § 103(a) as being unpatentable over AAPA in view of YOO is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

Dependent claim 22 depends from claim 16, and further recites that the step of ion-implanting the interstitial element comprises a step of ion-implanting the interstitial

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element at an implantation concentration of approximately  $1 \times 10^{14}$  atoms/cm<sup>2</sup> to  $1 \times 10^{16}$  atoms/cm<sup>2</sup> and at an implantation energy of approximately 0.3 KeV to 100 KeV.

While the Examiner acknowledges (see page 4 of the Office Action dated December 28, 2005) that AAPA and YOO fail to teach the recited implantation ranges, the Examiner explains that such ranges are merely obvious workable or optimum value ranges which can be determined with only routine experimentation.

Appellants respectfully disagree. The Examiner has not demonstrated that the recited ranges can be determined with only routine experimentation and Appellants have not conceded this point. Furthermore, the Examiner has failed to identify any prior art document or any disclosure in any of the applied documents which would support the Examiner's assertion.

The Examiner's assertion is clearly not supported by YOO which teaches ion implantation at significantly lower implantation concentrations. The result is, as was noted above, that, whereas the invention results in the low-vacancy regions 26 substantially overlapping the source and drain extension regions 24, the steps shown in Figs. 2 and 3 of YOO result in "oxide layers 38 at the interface between the source/drain regions 32 and the surrounding silicon substrate" (emphasis added). Thus, it is not inherent from the disclosure of YOO that such an implantation step would result the formation of low-vacancy regions that substantially overlap the source and drain extension regions.

Furthermore, to the extent that the Examiner relies upon official notice in support of the instant rejection, Appellants remind the Examiner that MPEP 2144.03 specifically {P27374 00109342.DOC}

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explains that “[o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known.” Appellants submit that the facts asserted by the Examiner, in view of the claimed invention, are not well known. The Examiner has also failed to provide any such documentary evidence. Accordingly, Appellants respectfully request that the Examiner produce documentary evidence to support the Examiner’s assertions to the extent that the Examiner is relying on official notice.

Because the combination of the above-noted documents fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellants submit that no proper combination of these documents renders unpatentable the combination of features recited in at least dependent claim 22.

**REJECTION OF DEPENDENT CLAIM 23 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 23 under 35 U.S.C. § 103(a) as being unpatentable over AAPA in view of YOO is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

Dependent claim 23 depends from claims 16 and 22, and further recites that a concentration peak of the interstitial element and a concentration peak of the N type impurity in the source and drain extension regions are formed at substantially the same depth from an upper surface of an Si cap layer.

While the Examiner acknowledges (see page 4 of the Office Action dated December 28, 2005) that AAPA and YOO fail to teach the recited concentration peak

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depth, the Examiner explains that this feature is merely an obvious workable or optimum value range which can be determined with only routine experimentation.

Appellants respectfully disagree. The Examiner has not demonstrated that the recited concentration peak depth values can be determined with only routine experimentation and Appellants have not conceded this point. Furthermore, the Examiner has failed to identify any prior art document or any disclosure in any of the applied documents which would support the Examiner's assertion.

The Examiner's assertion is clearly not supported by YOO which teaches ion implantation of the N-type impurity and the oxygen implant using different concentrations and different implant energy levels (see col. 3, line 60 to col. 4, line 4). The result is, as was noted above, that among other things, whereas the invention results in the low-vacancy regions 26 substantially overlapping the source and drain extension regions 24, the steps shown in Figs. 2 and 3 of YOO result in "oxide layers 38 at the interface between the source/drain regions 32 and the surrounding silicon substrate" (emphasis added). Thus, it is not inherent from the disclosure of YOO that such implantation steps using the recited concentration peaks of claim 23 would result in the formation of low-vacancy regions that substantially overlap the source and drain extension regions.

Furthermore, to the extent that the Examiner relies upon official notice in support of the instant rejection, Appellants remind the Examiner that MPEP 2144.03 specifically explains that "[o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common

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knowledge in the art are capable of instant and unquestionable demonstration as being well-known." Appellants submit that the facts asserted by the Examiner, in view of the claimed invention, are not well known. The Examiner has also failed to provide any such documentary evidence. Accordingly, Appellants respectfully request that the Examiner produce documentary evidence to support the Examiner's assertions to the extent that the Examiner is relying on official notice.

Because the combination of the above-noted documents fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellants submit that no proper combination of these documents renders unpatentable the combination of features recited in at least dependent claim 23.

**REJECTION OF DEPENDENT CLAIM 24 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 24 under 35 U.S.C. § 103(a) as being unpatentable over AAPA in view of YOO is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

Dependent claim 24 depends from claims 16, 22 and 23, and further recites that a concentration peak of the interstitial element is formed at a depth of approximately 10 Å to 20000 Å from the upper surface of the Si cap layer.

While the Examiner purports to support the rejection of this claim in the Office Action dated December 28, 2005, the Examiner has failed to provide any arguments in this Office Action, and in the Final Office Action, which even remotely discusses claim 24.

Furthermore, the Examiner has not demonstrated that the recited concentration

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peak depth value can be determined with only routine experimentation and Appellants have not conceded this point. Additionally, the Examiner has failed to identify any prior art document or any disclosure in any of the applied documents which would support the Examiner's assertion.

Furthermore, to the extent that the Examiner relies upon official notice in support of the instant rejection, Appellants remind the Examiner that MPEP 2144.03 specifically explains that "[o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known." Appellants submit that the facts asserted by the Examiner, in view of the claimed invention, are not well known. The Examiner has also failed to provide any such documentary evidence. Accordingly, Appellants respectfully request that the Examiner produce documentary evidence to support the Examiner's assertions to the extent that the Examiner is relying on official notice.

Because the combination of the above-noted documents fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellants submit that no proper combination of these documents renders unpatentable the combination of features recited in at least dependent claim 24.

**REJECTION OF DEPENDENT CLAIM 25 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 25 under 35 U.S.C. § 103(a) as being unpatentable over AAPA in view of YOO is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

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Dependent claim 25 depends from claim 16, and further recites the step of annealing.

While the Examiner identifies col. 4, lines 30-40 of YOO as teaching this feature in the Office Action dated December 28, 2005, the Examiner has failed to appreciate that the noted language of YOO merely discusses a "heat treatment" step. While it is true that annealing is a type of heat treatment, not all heat treatments utilize annealing, i.e., heat treatment is not *per se* annealing. Annealing, as the Examiner well knows, requires heating followed by slow cooling, and YOO entirely silent with regard to what type of heat treatment is utilized.

Furthermore, the Examiner has not demonstrated that the heat treatment of YOO would result in the a device which has low-vacancy regions substantially overlapping the source and drain extension regions.

Finally, to the extent that the Examiner relies upon official notice in support of the instant rejection, Appellants remind the Examiner that MPEP 2144.03 specifically explains that "[o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known." Appellants submit that the facts asserted by the Examiner, in view of the claimed invention, are not well known. The Examiner has also failed to provide any such documentary evidence. Accordingly, Appellants respectfully request that the Examiner produce documentary evidence to support the Examiner's assertions to the extent that the Examiner is relying on official notice.

Because the combination of the above-noted documents fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellants submit that no proper combination of these documents renders unpatentable the combination of features recited in at least dependent claim 25.

**REJECTION OF DEPENDENT CLAIM 26 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 26 under 35 U.S.C. § 103(a) as being unpatentable over AAPA in view of YOO is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

Dependent claim 26 depends from claims 16 and 25, and further recites that the step of annealing is performed at a temperature of approximately 700° C to 1200° C for approximately 1 second to 3 minutes.

While the Examiner acknowledges (see page 3 of the Office Action dated December 28, 2005) that AAPA and YOO fail to teach the recited annealing temperature and time ranges, the Examiner explains that such features are merely obvious workable or optimum ranges which can be determined with only routine experimentation.

Appellants respectfully disagree. The Examiner has not demonstrated that the recited ranges can be determined with only routine experimentation and Appellants have not conceded this point. Furthermore, the Examiner has failed to identify any prior art document or any disclosure in any of the applied documents which would support the Examiner's assertion.

The Examiner's assertion is also clearly not supported by YOO which, as was  
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noted above, does not even teach to use an annealing step.

Finally, to the extent that the Examiner relies upon official notice in support of the instant rejection, Appellants remind the Examiner that MPEP 2144.03 specifically explains that “[o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known.” Appellants submit that the facts asserted by the Examiner, in view of the claimed invention, are not well known. The Examiner has also failed to provide any such documentary evidence. Accordingly, Appellants respectfully request that the Examiner produce documentary evidence to support the Examiner’s assertions to the extent that the Examiner is relying on official notice.

Because the combination of the above-noted documents fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellants submit that no proper combination of these documents renders unpatentable the combination of features recited in at least dependent claim 26.

**REJECTION OF DEPENDENT CLAIM 28 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 28 under 35 U.S.C. § 103(a) as being unpatentable over AAPA in view of YOO is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

Dependent claim 28 depends from claims 16, 17 and 27, and further recites the step of providing an interstitial element in the source and drain regions.

While the Examiner identifies claim 1 of YOO as teaching this feature in the



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Office Action dated December 28, 2005, the Examiner has failed to appreciate that Figs. 2 and 3 of YOO shows that the oxygen 30 is implanted in the barrier region 38 at the edge of the source and drain extension region 32, and not in the source and drain regions 34 and 36.

Finally, to the extent that the Examiner relies upon official notice in support of the instant rejection, Appellants remind the Examiner that MPEP 2144.03 specifically explains that "[o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known." Appellants submit that the facts asserted by the Examiner, in view of the claimed invention, are not well known. The Examiner has also failed to provide any such documentary evidence. Accordingly, Appellants respectfully request that the Examiner produce documentary evidence to support the Examiner's assertions to the extent that the Examiner is relying on official notice.

Because the combination of the above-noted documents fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellants submit that no proper combination of these documents renders unpatentable the combination of features recited in at least dependent claim 28.

**REJECTION OF DEPENDENT CLAIM 31 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 31 under 35 U.S.C. § 103(a) as being unpatentable over AAPA in view of YOO is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

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Dependent claim 31 depends from claim 16, and further recites forming sidewalls on side surfaces of a gate electrode before the ion implanting, whereby the gate electrode is protected from the ion implanting.

While the Examiner identifies Figs. 1-3 and the description thereof of YOO as teaching this feature in the Final Office Action, the Examiner has failed to appreciate the fact that it is clear from the description of Figs. 2 and 3, as well as the drawings themselves, the oxygen implantation 30 occurs before the sidewalls 33 are formed. Claim 31, on the other hand, specifically recites that the ion implanting occurs after the sidewalls are formed. Furthermore, the Examiner has failed to identified any disclosure in YOO which discloses or suggest that the steps shown Figs. 2 and 3 of YOO (which clearly show that the ion implanting occurs before the sidewalls are formed) could be reversed.

Finally, to the extent that the Examiner relies upon official notice in support of the instant rejection, Appellants remind the Examiner that MPEP 2144.03 specifically explains that “[o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known.” Appellants submit that the facts asserted by the Examiner, in view of the claimed invention, are not well known. The Examiner has also failed to provide any such documentary evidence. Accordingly, Appellants respectfully request that the Examiner produce documentary evidence to support the Examiner’s assertions to the extent that the Examiner is relying on official notice.

Because the combination of the above-noted documents fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellants submit that no proper combination of these documents renders unpatentable the combination of features recited in at least dependent claim 31.

**REJECTION OF DEPENDENT CLAIM 32 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 32 under 35 U.S.C. § 103(a) as being unpatentable over AAPA in view of YOO is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

Dependent claim 32 depends from claim 16, and further recites that the vacancy concentration is reduced by annihilation of excess vacancies in the source and drain extension regions.

While the Examiner has alleged that this feature is taught by the combination of AAPA and YOO, the Examiner has failed to identify any specific disclosure in AAPA or YOO to support this allegation.

Furthermore, YOO contains no disclosure whatsoever even mentioning the annihilation of excess vacancies in the source and drain extension regions.

Finally, to the extent that the Examiner relies upon official notice in support of the instant rejection, Appellants remind the Examiner that MPEP 2144.03 specifically explains that "[o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known." Appellants submit that the facts asserted by the Examiner, in view of the

claimed invention, are not well known. The Examiner has also failed to provide any such documentary evidence. Accordingly, Appellants respectfully request that the Examiner produce documentary evidence to support the Examiner's assertions to the extent that the Examiner is relying on official notice.

Because the combination of the above-noted documents fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellants submit that no proper combination of these documents renders unpatentable the combination of features recited in at least dependent claim 32.

**REJECTION OF DEPENDENT CLAIM 33 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 33 under 35 U.S.C. § 103(a) as being unpatentable over AAPA in view of YOO is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

Dependent claim 33 depends from claim 16, and further recites that the ion implanting occurs before the forming of the source and drain extension regions.

While the Examiner acknowledges on page 3 of the Final Office Action that this feature is not taught in YOO and instead teaches the opposite of what is claimed, the Examiner nevertheless asserts that it would have been obvious to reverse the ion implanting and the forming steps. Appellants respectfully disagree. YOO only discusses that the oxygen implantation 30 can occur after the implanting of the N-type impurity. The Examiner has failed to identified any disclosure in YOO or the AAPA which discloses or suggest that the steps can be reversed.

Finally, to the extent that the Examiner relies upon official notice in support of the

instant rejection, Appellants remind the Examiner that MPEP 2144.03 specifically explains that "[o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known." Appellants submit that the facts asserted by the Examiner, in view of the claimed invention, are not well known. The Examiner has also failed to provide any such documentary evidence. Accordingly, Appellants respectfully request that the Examiner produce documentary evidence to support the Examiner's assertions to the extent that the Examiner is relying on official notice.

Because the combination of the above-noted documents fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellants submit that no proper combination of these documents renders unpatentable the combination of features recited in at least dependent claim 33.

**REJECTION OF DEPENDENT CLAIM 34 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 34 under 35 U.S.C. § 103(a) as being unpatentable over AAPA in view of YOO is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

Dependent claim 34 depends from claim 16, and further recites, before the ion implanting, forming sidewalls on side surfaces of a gate electrode, wherein the interstitial element comprises an N-type impurity.

While the Examiner asserts on page 3 of the Final Office Action that this feature is obvious, the Examiner has failed to appreciate the fact that, it is clear from the

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description of Figs. 2 and 3, as well as the drawings themselves, that the oxygen implantation 30 occurs before the sidewalls 33 are formed. Claim 34, on the other hand, specifically recites that the ion implanting occurs after the sidewalls are formed. Furthermore, the Examiner has failed to identified any disclosure in YOO which discloses or suggest that the steps shown Figs. 2 and 3 of YOO (which clearly show that the ion implanting occurs before the sidewalls are formed) could be reversed.

Finally, to the extent that the Examiner relies upon official notice in support of the instant rejection, Appellants remind the Examiner that MPEP 2144.03 specifically explains that "[o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known." Appellants submit that the facts asserted by the Examiner, in view of the claimed invention, are not well known. The Examiner has also failed to provide any such documentary evidence. Accordingly, Appellants respectfully request that the Examiner produce documentary evidence to support the Examiner's assertions to the extent that the Examiner is relying on official notice.

Because the combination of the above-noted documents fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellants submit that no proper combination of these documents renders unpatentable the combination of features recited in at least dependent claim 34.

**REJECTION OF DEPENDENT CLAIM 35 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 35 under 35 U.S.C. § 103(a) as being unpatentable over  
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AAPA in view of YOO is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

Dependent claim 35 depends from claim 16, and further recites that the interstitial element creates additional interstitials which react with and annihilate excess vacancies in the SiGe based substrate.

While the Examiner has alleged that this feature is inherently taught by the combination of AAPA and YOO, the Examiner has failed to identify any specific disclosure in AAPA or YOO to support this allegation.

Furthermore, YOO contains no disclosure whatsoever even mentioning the annihilation of excess vacancies.

Finally, to the extent that the Examiner relies upon official notice in support of the instant rejection, Appellants remind the Examiner that MPEP 2144.03 specifically explains that "[o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known." Appellants submit that the facts asserted by the Examiner, in view of the claimed invention, are not well known. The Examiner has also failed to provide any such documentary evidence. Accordingly, Appellants respectfully request that the Examiner produce documentary evidence to support the Examiner's assertions to the extent that the Examiner is relying on official notice.

Because the combination of the above-noted documents fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellants

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submit that no proper combination of these documents renders unpatentable the combination of features recited in at least dependent claim 35.

**REJECTION OF DEPENDENT CLAIM 36 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 36 under 35 U.S.C. § 103(a) as being unpatentable over AAPA in view of YOO is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

Dependent claim 36 depends from claim 16, and further recites that the ion implanting reduces an N-type impurity in the source and drain regions, thereby improving roll-off characteristics.

While the Examiner has alleged that this feature is inherently taught by the combination of AAPA and YOO, the Examiner has failed to identify any specific disclosure in AAPA or YOO to support this allegation.

Furthermore, YOO contains no disclosure whatsoever even mentioning that the ion implanting of oxygen 30 reduces an N-type impurity in the source and drain regions, much less, that this improves roll-off characteristics.

Furthermore, the Examiner has failed to appreciate that Figs. 2 and 3 of YOO show that the oxygen 30 is implanted in the barrier region 38 at the edge of the source and drain extension region 32, and not in the source and drain regions 34 and 36. As a result, it is not apparent how the implanting of oxygen 30 to an edge of the source and drain extension region 32 would result in reducing the N-type impurity of the source and drain regions 34 and 36.

Finally, to the extent that the Examiner relies upon official notice in support of the

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instant rejection, Appellants remind the Examiner that MPEP 2144.03 specifically explains that “[o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known.” Appellants submit that the facts asserted by the Examiner, in view of the claimed invention, are not well known. The Examiner has also failed to provide any such documentary evidence. Accordingly, Appellants respectfully request that the Examiner produce documentary evidence to support the Examiner’s assertions to the extent that the Examiner is relying on official notice.

Because the combination of the above-noted documents fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellants submit that no proper combination of these documents renders unpatentable the combination of features recited in at least dependent claim 36.

**REJECTION OF DEPENDENT CLAIM 37 UNDER 35 U.S.C. § 103 IS IN ERROR**

The rejection of claim 37 under 35 U.S.C. § 103(a) as being unpatentable over AAPA in view of YOO is in error, the decision of the Examiner to reject this claim should be reversed, and the application should be remanded to the Examiner.

Dependent claim 37 depends from claim 16, and further recites that the ion implanting is performed in a self-aligned manner by using a gate electrode as a mask.

While the Examiner identifies Figs. 1-3 and the description thereof of YOO as teaching this feature in the Final Office Action, the Examiner has failed to appreciate the fact that it is clear from the description of Figs. 2 and 3, as well as the drawings

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themselves, the oxygen implantation 30 occurs at an angle of between 30 and 60 degrees (see col. 4, line 4-7). Thus, it is not apparent that such an implantation step occurs in a self-aligned manner. Appellants remind the Examiner that the ion implantation shown in Fig. 4 of the instant application clearly shows that the ion implantation B occurs in a self-aligned manner (using the gate electrode 18 as a mask) over most of the source/drain extension regions 24, and that, as a result, the low-vacancy regions 26 substantially overlap the source and drain extension regions 24.

Finally, to the extent that the Examiner relies upon official notice in support of the instant rejection, Appellants remind the Examiner that MPEP 2144.03 specifically explains that "[o]fficial notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known." Appellants submit that the facts asserted by the Examiner, in view of the claimed invention, are not well known. The Examiner has also failed to provide any such documentary evidence. Accordingly, Appellants respectfully request that the Examiner produce documentary evidence to support the Examiner's assertions to the extent that the Examiner is relying on official notice.

Because the combination of the above-noted documents fails to disclose, or even suggest, at least the above-noted features of the instant invention, Appellants submit that no proper combination of these documents renders unpatentable the combination of features recited in at least dependent claim 37.

**(VIII) CONCLUSION**

Each of claims 16-18, 22-28 and 30-39 are patentable under 35 U.S.C. § 103(a). Specifically, the applied art of record, even in properly combined, fails to disclose or suggest the unique combination of features recited in Appellants' claims 16-18, 22-28 and 30-39. Accordingly, Appellants respectfully request that the Board reverse the decision of the Examiner to reject claims 16-18, 22-28 and 30-39 under 35 U.S.C. §103(a), and remand the application to the Examiner for withdrawal of the above-noted rejections.

Respectfully submitted,  
Dureseti CHIDAMBARRAO, et al.



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Attachments: Claims Appendix, Evidence Appendix, and Related Proceedings Appendix

CLAIMS ON APPEAL

16. A method for reducing diffusion of an N type impurity in a SiGe-based substrate, the method comprising steps of:

forming source and drain extension regions in an upper surface of the SiGe-based substrate; and

ion implanting an interstitial element into the source and drain extension regions to reduce vacancy concentration in the source and drain extension regions and to form low-vacancy regions that substantially overlap the source and drain extension regions.

17. The method of claim 16, wherein the interstitial element is Si or O.

18. The method of claim 16, further comprising a step of forming source and drain regions.

22. The method of claim 16, wherein the step of ion-implanting the interstitial element comprises a step of ion-implanting the interstitial element at an implantation concentration of approximately  $1 \times 10^{14}$  atoms/cm<sup>2</sup> to  $1 \times 10^{16}$  atoms/cm<sup>2</sup> and at an implantation energy of approximately 0.3 KeV to 100 KeV.

23. The method of claim 22, wherein a concentration peak of the interstitial element and a concentration peak of the N type impurity in the source and drain extension regions are formed at substantially the same depth from an upper surface of an Si cap layer.

24. The method of claim 23, wherein the concentration peak of the interstitial element is formed at a depth of approximately 10 Å to 20000 Å from the upper surface of the Si cap layer.

25. The method of claim 16, further comprising a step of annealing.

26. The method of claim 25, wherein the step of annealing is performed at a temperature of approximately 700° C to 1200° C for approximately 1 second to 3 minutes.

27. The method of claim 17, further comprising a step of forming source and drain regions in the upper surface of the SiGe-based substrate, the source and drain regions containing the N type impurity and overlapping the source and drain extension regions.

28. The method of claim 27, further comprising a step of providing an interstitial element in the source and drain regions.

30. The method of claim 16, further comprising forming an Si cap layer on the SiGe based substrate and straining biaxially in tension the Si cap layer to match an underlying relaxed SiGe lattice.

31. The method of claim 16, further comprising forming sidewalls on side surfaces of a gate electrode before the ion implanting, whereby the gate electrode is protected from the ion implanting.

32. The method of claim 16, wherein the vacancy concentration is reduced by annihilation of excess vacancies in the source and drain extension regions.

33. The method of claim 16, wherein the ion implanting occurs before the forming.

34. The method of claim 16, further comprising, before the ion implanting, forming sidewalls on side surfaces of a gate electrode, wherein the interstitial element comprises an N-type impurity.

35. The method of claim 16, wherein the interstitial element creates additional interstitials which react with and annihilate excessive vacancies in the SiGe based substrate.

36. The method of claim 16, wherein the ion implanting reduces an N-type impurity in source and drain regions, thereby improving roll-off characteristics.

37. The method of claim 16, wherein the ion implanting is performed in a self-aligned manner by using a gate electrode as a mask.

38. A method for reducing diffusion of an N type impurity in a SiGe substrate, the method comprising steps of:

- forming an Si cap layer on the SiGe substrate;

- forming a gate electrode on the Si cap layer;

- forming sidewalls on sides of the gate electrode;

- forming source and drain extension regions in an upper surface of the SiGe-based substrate; and

- ion implanting an interstitial element into the source and drain extension regions to reduce vacancy concentration in the source and drain extension regions, wherein the ion implanting occurs after the sidewalls are formed.

39. A method for reducing diffusion of an N type impurity in a SiGe substrate, the method comprising steps of:

- forming an Si cap layer on the SiGe substrate;

- forming a gate electrode on the Si cap layer;

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forming sidewalls on sides of the gate electrode;

forming source and drain extension regions in an upper surface of the SiGe substrate; and

reducing a vacancy concentration in the source and drain extension regions using ion implantation in order to annihilate excess vacancies or trap vacancies,

wherein the reducing occurs after the sidewalls are formed and forms low-vacancy regions that substantially overlap the source and drain extension regions.

EVIDENCE APPENDIX

This section lists evidence submitted pursuant to 35 U.S.C. §§1.130, 1.131, or 1.132, or any other evidence entered by the Examiner and relied upon by Appellant in this appeal, and provides for each piece of evidence a brief statement setting forth where in the record that evidence was entered by the Examiner. Copies of each piece of evidence are provided as required by 35 U.S.C. §41.37(c)(ix).

NO.	EVIDENCE	BRIEF STATEMENT SETTING FORTH WHERE IN THE RECORD THE EVIDENCE WAS ENTERED BY THE EXAMINER
1	N/A	N/A



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RELATED PROCEEDINGS APPENDIX

Pursuant to 35 U.S.C. §41.37(c)(x), copies of the following decisions rendered by a court of the Board in any proceeding identified above under 35 U.S.C. §41.37(c)(1)(ii) are enclosed herewith.

NO.	TYPE OF PROCEEDING	REFERENCE NO.	DATE
1	N/A	N/A	N/A